

REMARKS

The present application has been reviewed in light of the Office Action dated December 10, 2009. A Request for Continued Examination (RCE) Transmittal was filed herewith. Claims 1 and 4 are presented for examination. Claim 1, which is the only claim in independent form, has been amended to define aspects of Applicant's invention more clearly. Favorable consideration is requested.

The Office Action states that Claim 1 is rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,071,297 (Leitz et al.) in view of U.S. Patent No. 6,809,768 (Merrill)¹; and that Claim 4 is rejected under § 103(a) as being unpatentable over Leitz et al. in view of Merrill, and further in view of U.S. Patent No. 5,760,852 (Wu et al.). For at least the reasons presented below, Applicant submits that independent Claim 1 and Claim 4 dependent therefrom are patentably distinct from the cited references.

Claim 1 is directed to an image pickup apparatus that includes a plurality of pixels and an output unit. Each pixel includes first and second sensitive areas, which receive light flux respectively corresponding to different areas of an exit pupil of an imaging optical system. Each pixel also includes two photoelectric conversion portions formed therein based on the first and second sensitive areas so that a sensitivity distribution of the first sensitive area and a sensitivity distribution of the second sensitive area partially overlap in an area interposed between the two

¹Applicant notes that on page 3 of the Office Action, in section 3 thereof, it states that Claim 1 is rejected over Leitz et al. in view of "Mimura et al. (US Patent # 6,927,792)." The discussion in section 3, however, is directed to Leitz et al. in view of *U.S. Patent No. 6,809,768 to Merrill*, which is of record in the present application. Because section 3 does not cite any portion of Mimura et al. as being relevant to Claim 1, Applicant has interpreted the rejection of Claim 1 to be over Leitz et al. in view of Merrill and not in view of Mimura et al.

photoelectric conversion portions of the pixel. The output unit functions to receive a first electric signal and a second electric signal from each of the plurality of pixels, and to detect and output a phase difference between corresponding first and second electric signals from each of the plurality of pixels. The first and second sensitive areas of each of the plurality of pixels are arranged so that corresponding first and second electric signals, received by the output unit, each includes signals generated in the first and second sensitive areas of a corresponding one of the plurality of pixels.

A notable feature of Claim 1 is that, within a pixel, the first and second sensitive areas and the two photoelectric conversion portions are arranged so that the sensitivity distribution of the first sensitive area partially overlaps the sensitivity distribution of the second sensitive area in a region situated between the two photoelectric conversion portions. An example of this arrangement is illustrated in Figs. 8 and 9, and an example of the corresponding overlapping sensitivity distributions is illustrated in Figs. 10 and 11. Beneficial aspects of this feature can be understood by understanding the problems caused by conventional arrangements of photoelectric conversion portions within a pixel.²

One such conventional arrangement is shown in Fig. 39. As shown in this figure, a floating diffusion (“FD”) region 131 is positioned between two photodiodes 129 and 130. The two photodiodes 129 and 130 contribute to two regions on a corresponding exit pupil, as shown in Fig. 40. However, the presence of the FD region 131 between the two photodiodes 129 and 130 causes a gap or separation to be present between the two regions. As a consequence of this

²The examples presented herein are intended to be used for purposes of illustration and are not to be construed to limit the scope of the claims.

separation, light that falls between the two photodiodes 129 and 130 does not get converted into carriers, thus causing the exit pupil separation between the two regions, as illustrated in Fig. 40. (A more detailed explanation of the exit pupil separation problem in prior-art arrangements may be found in paragraphs [0008] - [0026] of U.S. Patent Application Publication No. 2002/0121652 corresponding to the present application.)

In contrast to the conventional arrangement discussed above, the arrangement of Claim 1 eliminates the exit pupil separation problem by positioning the two photoelectric conversion portions such that the sensitivity distributions of the first and second sensitive areas partially overlap in the region between the two photoelectric conversion portions, as illustrated in Figs. 10 and 11, for example. As a result, no gap or separation is present in the exit pupil, as illustrated in Fig. 12, for example.

Leitz et al. relates to a system for determining the position of a focal plane of an image. As conceded in the Office Action, Leitz et al. fails to teach an arrangement in which the sensitivity distributions of first and second sensitive areas partially overlap. Applicant concurs with this assessment of Leitz et al.

Merrill relates to a pixel sensor array with first and second photodiodes 12 and 14, one photodiode 12 being larger than the other photodiode 14. As understood by Applicant, Merrill teaches the use of first and second reset switches 18 and 20, which selectively reset the first and second photodiodes 12 and 14. A description of the function of the first and second photodiodes 12 and 14 and the first and second reset switches 18 and 20 is given at column 3, line 65, to column 5, line 36, of Merrill.

The Office Action alleges that Fig. 2 and column 4, lines 27-44, of Merrill teach the feature of partially overlapping first and second sensitive areas of a pixel. Applicant respectfully disagrees with this interpretation of Merrill, and submit that the cited portion of Merrill reads as follows:

Under these conditions, integration of photocharge begins. Charge from the cathode of large photodiode 12 accumulates at the gate terminal of N-Channel MOS source-follower transistor 22 and charge from the cathode of small photodiode 14 accumulates at the gate terminal of N-Channel MOS source-follower transistor 24. The rate of voltage change at the output column line or the common source node of source-follower transistors 22 and 24 of a sensor in a selected row as a function of accumulated light during this period is shown in the transfer curve of FIG. 2 as the steeply sloped line "A" beginning at about 3 volts on the Y axis. Typically, this voltage is only realized after the end of integration, during a readout phase, when the row-select transistor is turned on. The initial steep portion of line "C" represents the pixel sensor output voltage on the column line that follows below line "A" at a difference of a transistor threshold voltage.

Nothing in the cited portion of Merrill is understood to even relate to a sensitivity distribution nor to the partial overlap of two sensitivity distributions.

It is respectfully submitted that curves A and B of Fig. 2 merely show the charge accumulation rates of the large and small photodiodes 12 and 14, respectively. As described at column 4, lines 49-54, of Merrill: "Because the area of photodiode 14 is small compared to the area of photodiode 12, the rate of accumulation of charge on the cathode of small photodiode 14 is slower than the rate of charge accumulation on the cathode of large photodiode 12 as may be seen by comparing the slopes of lines "A" and "B" of FIG. 2." Further, as described at column 5, lines 18-24, of Merrill: "Persons of ordinary skill in the art will recognize that the individual slopes of lines "A" and "B" in FIG. 2 will be determined by the sizes of photodiodes 12 and 14

and capacitance values of the circuit. The intersection between the lines “A” and “B”, or the break point in the curve “C”, corresponds to a threshold amount of accumulated light at which the response changes from high gain to low gain.”

Applicant submits that Merrill is completely silent regarding a structure that avoids the above-described exit pupil separation problem in the prior art, which problem is addressed in Claim 1 by providing two photoelectric conversion portions formed in a pixel based on first and second sensitive areas, such that a sensitivity distribution of the first sensitive area and a sensitivity distribution of the second sensitive area partially overlap in an area interposed between the two photoelectric conversion portions of the pixel.

In summary, Applicant submits that a combination of Leitz et al. and Merrill, assuming such combination would even be permissible, would fail to teach or suggest an image pickup apparatus that includes a plurality of pixels, in which “each pixel includes a first sensitive area and a second sensitive area,” in which “the first and second sensitive areas of a pixel receive light flux respectively corresponding to different areas of an exit pupil of an imaging optical system,” and in which “each pixel includes two photoelectric conversion portions formed therein based on the first and second sensitive areas of the pixel so that a sensitivity distribution of the first sensitive area and a sensitivity distribution of the second sensitive area partially overlap in an area interposed between the two photoelectric conversion portions of the pixel,” as recited in Claim 1. Accordingly, Applicant submits that Claim 1 is patentable over the cited references and respectfully requests withdrawal of the rejection under 35 U.S.C. § 103(a).

Claim 4 depends from Claim 1 and therefore is submitted to be patentable for at least the reasons discussed above. However, because each dependent claim also is deemed to

define an additional aspect of the invention, individual consideration of the patentability of Claim 4 on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicant respectfully requests favorable consideration and an early passage to issue of the present application.

No petition to extend the time for response to the Office Action is deemed necessary for this Amendment. If, however, such a petition is required to make this Amendment timely filed, then this paper should be considered such a petition and the Commissioner is authorized to charge the requisite petition fee to Deposit Account 50-3939.

Applicant's undersigned attorney may be reached in our New York Office by telephone at (212) 218-2100. All correspondence should continue to be directed to our address listed below.

Respectfully submitted,

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